User Manual

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4. Introduction

4.1. OptoNAV

The OptoNAV system assists the RTG operator by providing a visual camera reference of the RTG in relation to the driveline. Two cameras mounted each side of the vehicle continually monitor the direction, angle and accuracy of the RTG to the driveline by image processing techniques. The Northing and Easting position derived from these images are then compared with given system parameters. Any RTG deviation from these parameters will be visually displayed to the Operator via the traffic light display screen in the cabin. By interfacing the OptoNAV system with the onboard RTG "Assisted Steering Module" it can provide a seamless reliable fallback in the event of poor GPS data. Therefore OptoNAV will still give the Operator a continuous visual of driveline accuracy or obstructions.

4.2. System Overview

The OptoNAV system is a combination of hardware and software that provides the user with the ability to navigate using machine vision. The diagram below shows the OptoNAV system design.

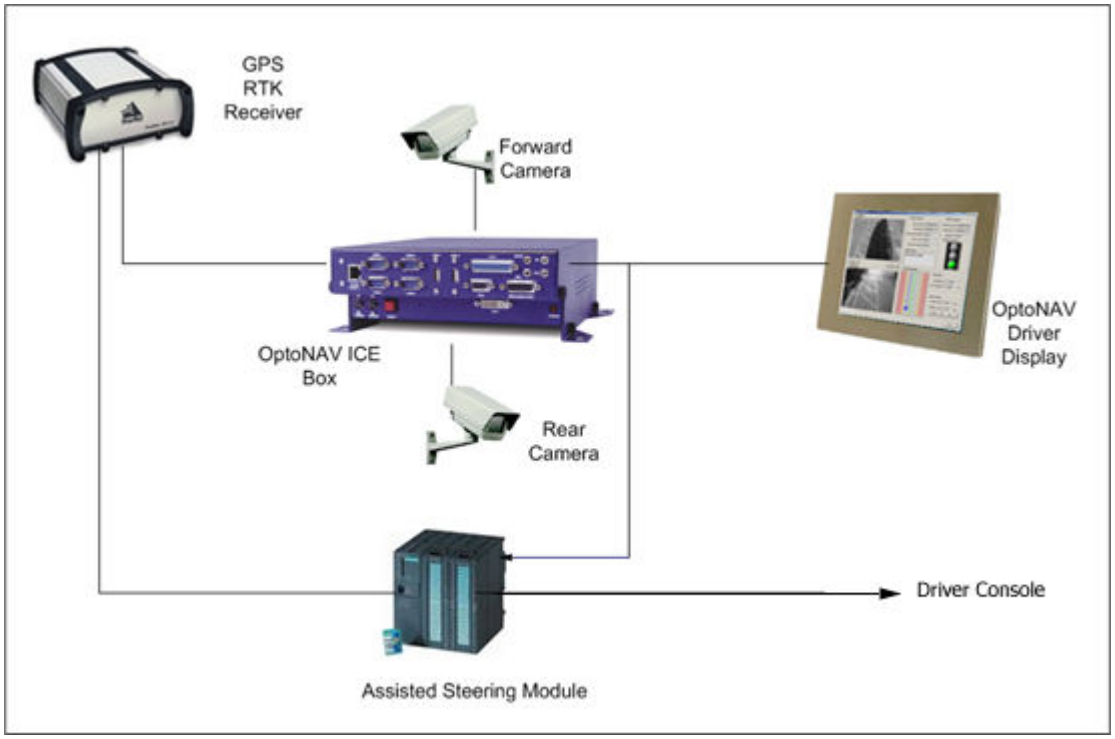


Figure 1 OptoNAV System Diagram

4.3. System Details

The OptoNAV system consists of the following components.

- OptoNAV ICE Box Industrial PC with OptoNAV software pre-installed
- OptoNAV ICE Box Industrial PC Mains Adapter
- 2x High Performance Colour CCD Camera with lens
- Combined Video and Power Cable
- Phono to BNC Adapter (pre-fitted to cable)
- Mains adapter for above camera
- OptoNAV CD containing PC software and manual

4.4. Camera Feed

OptoNAV utilises two cameras positioned to face both possible drive directions. The live images from the camera provide the means to determine the heading of the RTG as well as providing a means to observe the area in front and behind the RTG.
Figure 2, below, shows an example image received by one of the cameras. Both camera feeds are displayed on the OptoNAV interface.

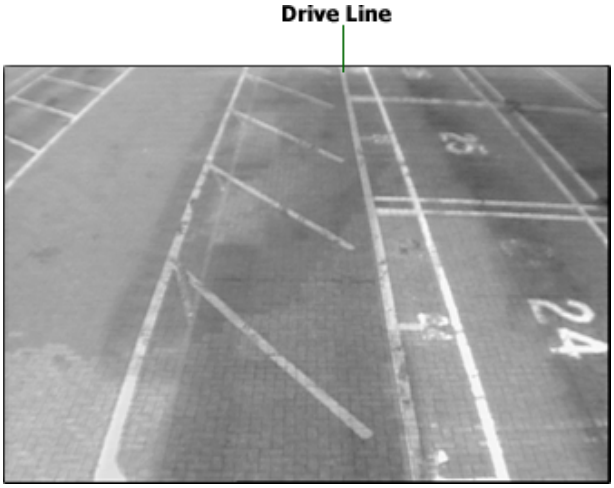


Figure 2 Camera Feed with drive line

The cameras are positioned on one leg of the RTG and provide an area of view as shown below. It should be noted that the cameras do not provide visual coverage closer than 1.77 meters from the RTG leg.
This is represented in the diagram below.

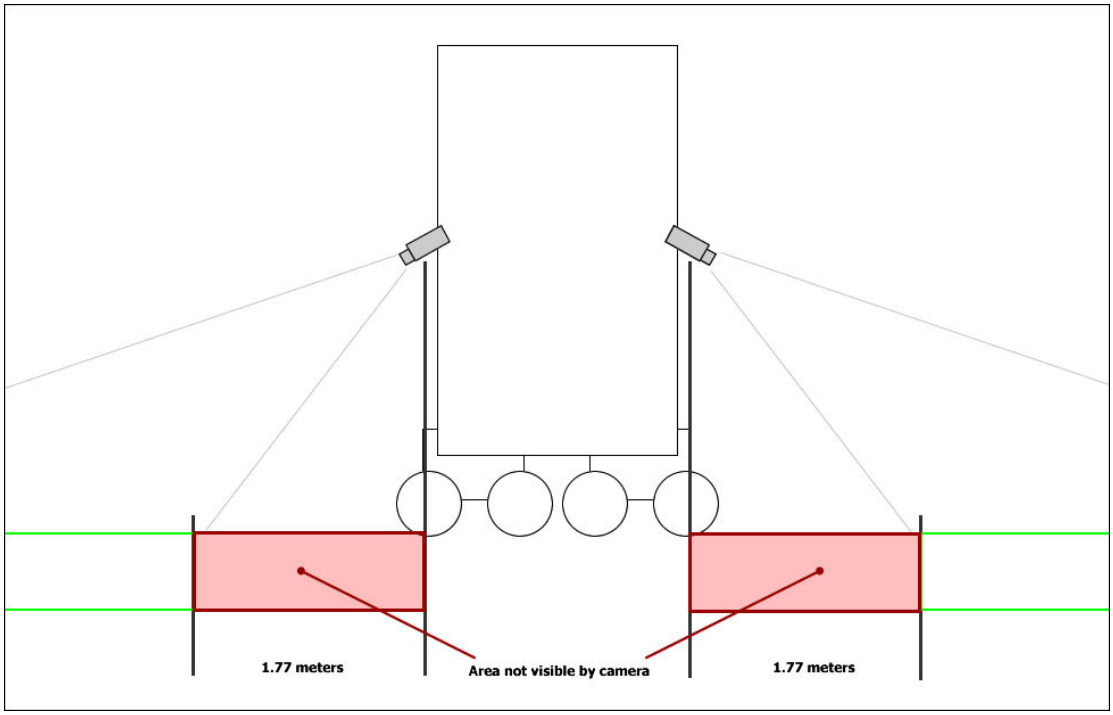


Figure 3 Camera Visibility

5. OptoNAV Software

5.1. Start-up

OptoNAV will start automatically when the RTG system is turned on.

5.2. Layout

The OptoNAV software starts automatically on system power up.

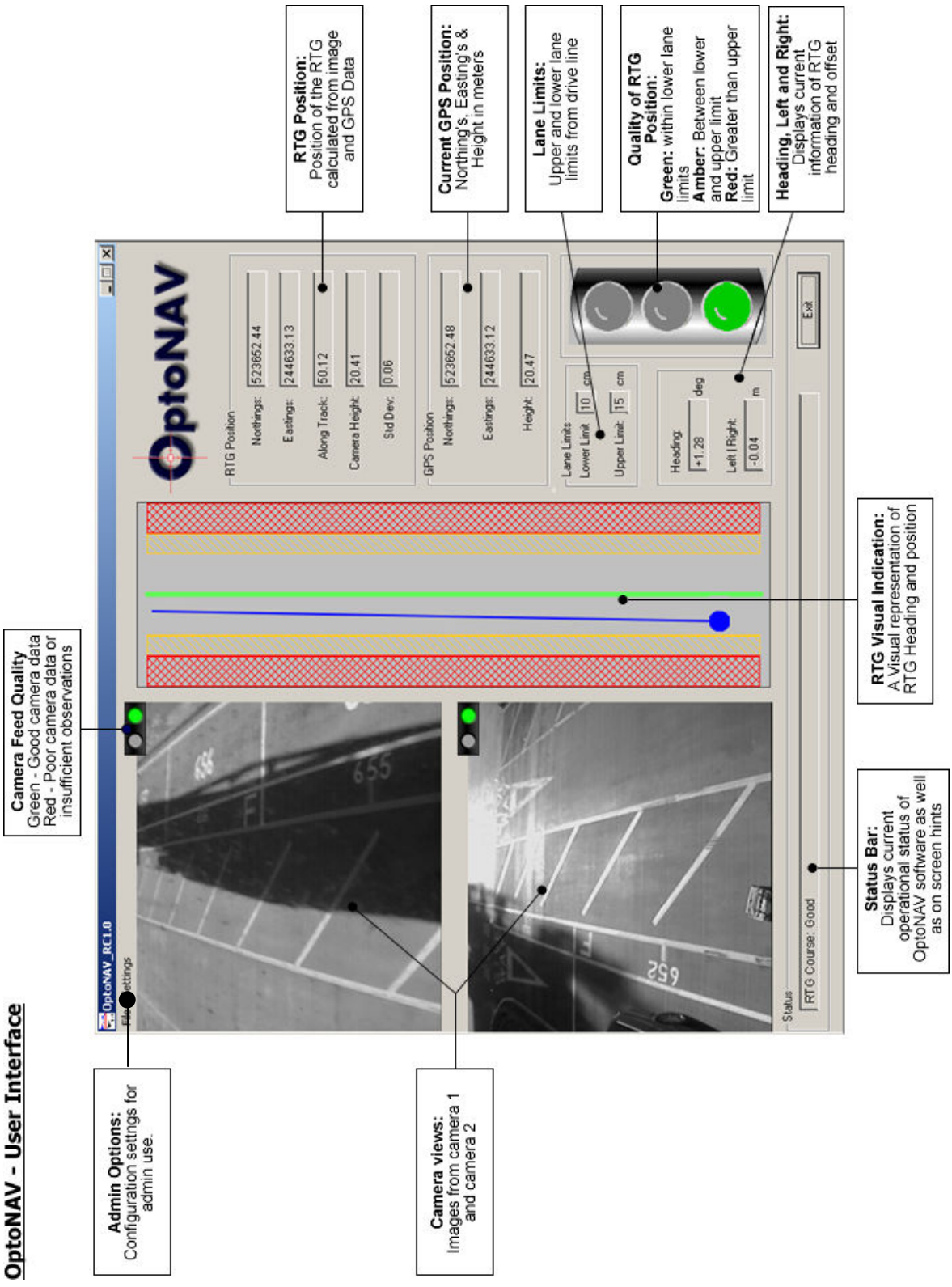
The OptoNAV software consists of a simple user friendly interface that requires minimal interaction.
The display shows:

- Live feeds from camera one and camera two
- Visual representation of the RTG position and heading
- RTG position data
- GPS position data
- Lane limits
- RTG position quality
- Heading information
- Status bar

Note: On start-up of the OptoNAV software, an initial picture is taken from the camera, no live video will be displayed at this point.

5.3. Layout Guides

The following images show the OptoNAV user interface and provide a breakdown for each section.


OptoNAV - User Interface
RTG Position: Position of the RTG calculated from image and GPS Data
Current GPS Position: Northing's, Easting's & Height in meters
Lane Limits: Upper and lower lane limits from drive line
Quality of RTG Position: Green: within lower lane limits Amber: Between lower and upper limit Red: Greater than upper limit
Heading, Left and Right: Displays current information of RTG heading and offset
Camera Feed Quality Green - Good camera data Red - Poor camera data or insufficient observations
RTG Visual Indication: A Visual representation of RTG Heading and position
Status Bar: Displays current operational status of OptoNAV software as well as on screen hints
Admin Options: Configuration settings for admin use.
Camera views: Images from camera 1 and camera 2
OptoNAV
RTG Position
Northings: 523652.44
Eastings: 244633.13
Along Track: 50.12
Camera Height: 20.41
Std Dev: 0.06
GPS Position
Northings: 523652.48
Eastings: 244633.12
Height: 20.47
Lane Limits
Lower Limit: 10 cm
Upper Limit: 15 cm
Heading: +1.28 deg
Left / Right: -0.04 m
Exit
OptoNAV_RC1.0
File Settings
Status
RTG Course: Good

5.4. RTG Visual Indication

The RTG visual indication displays the heading and position of the RTG in comparison with the drive line. The drive line is shown in green and the RTG is shown by the blue circle with its heading displayed by the blue line. If there is any movement by the RTG to the left or right this will be displayed by movement of the blue circle to the left or right. The lane limits are displayed by the amber and red shadings.

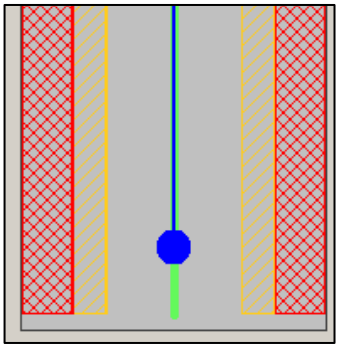


Figure 4 RTG Visual Indication

5.5. RTG Position

The RTG position box shows:

Northings: Northing RTG position calculated from the image and the available GPS data.
Eastings: Easting RTG position calculated from the image and the available GPS data.
Along Track: Distance the RTG has moved from its originating position
Camera Height: Height of the camera from the floor.
Std Dev: The quality of the position in meters.

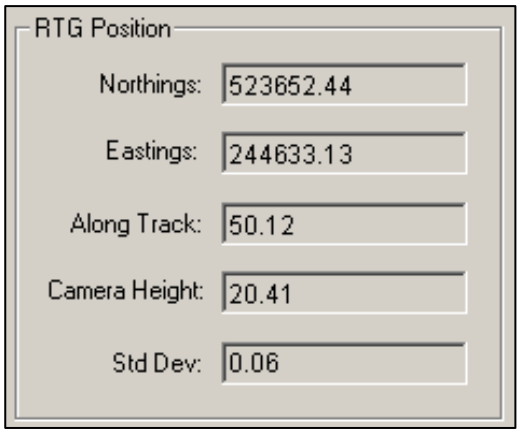


Figure 5 RTG Position

5.6. GPS Position

The GPS position box shows:

Northings: Northing position received from GPS receiver in meters.
Eastings: Eastings position received from GPS receiver in meters.
Height: Height from sea-level received from GPS receiver.

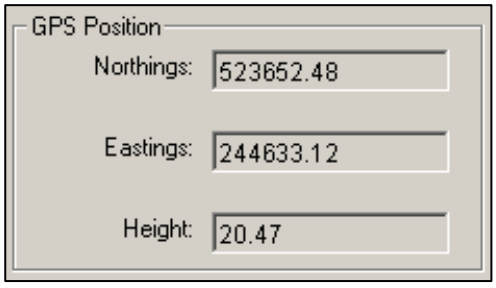


Figure 6 GPS Position

5.7. Lane Limits

The Lane Limits section provides a guideline for the cranes movement from the drive line. They are provided as a safety mechanism. As a default this is set as +/- 10 centimeters for the lower limit and +/- 15 for the upper limit. If this threshold is reached an alert will display on the status bar and the traffic light. The lane limits can be adjusted by an expert user in the administrator options.

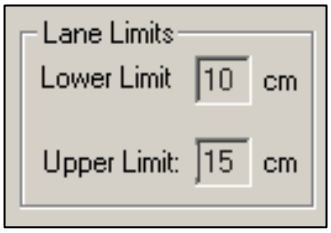


Figure 7 Lane Limits

5.8. Direction Indicator

The direction indicator will provide information on the RTG's heading and it's offset. The heading data is displayed in degrees relative to the drive line. The Left | Right data is provided in meters from the drive line.

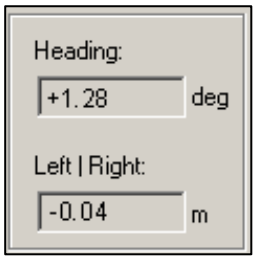


Figure 8 Direction Indicator

5.9. Status Bar

The Status bar displays the the operational status of the OptoNAV software . this will also prompt the user when input is required and provide hints for operation. The messages are displayed in the tabl below.

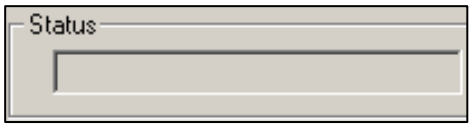


Figure 9 Status Bar

5.10. Status Messages

Message	Meaning
Left click on furthest visible point on drive line 1	Using the mouse left click on the furthest point of drive line 1 (The drive line located in the Camera 1 view field)
Left click on nearest visible point on drive line 1	Using the mouse left click on the nearest point of drive line 1 (The drive line located in the Camera 1 view field)
Left click on furthest visible point on drive line 2	Using the mouse left click on the furthest point of drive line 2 (The drive line located in the Camera 2 view field)
Left click on nearest visible point on drive line 2	Using the mouse left click on the nearest point of drive line 2 (The drive line located in the Camera 2 view field)
Both Lines Defined	A drive line has been defined in both camera views
Course Good!	RTG is within the lower lane limits
Heading off course!!	RTG has exceeded the lower lane limit but is still within the upper lane limit
Check Position of Drive Line!!!	RTG has exceeded the upper lane limit
RECORDING!!!	Auto Record function has been activated and is recording data
BAD CAMERA 1 DATA	Poor image conditions or insufficient data for camera 1 to calculate RTG navigation
BAD CAMERA 2 DATA	Poor image conditions or insufficient data for camera 2 to calculate RTG navigation
BAD CAMERA 1 & 2 DATA	Poor image conditions or insufficient data for both cameras to calculate RTG navigation

5.11. Traffic Light Status

OptoNAV uses a traffic light system to prompt the system status displaying either a green, amber or red light. The status is displayed along the bottom of the user interface.

Green Light
A green light will be displayed if the drive line is visible in both measure boxes and the RTG is travelling on good course.

Amber Light
When the amber light is displayed the drive line is only visible in one measure box. There are several reasons for this:

- Drive Line has become worn or is obscured
- RTG has exceeded the lower lane limits and is moving off course

Red Light
The Red light is displayed if the drive line is not visible in either measure boxes.

- Drive Lines have become worn or both are obscured
- RTG has exceeded the upper lane limits and is off course

5.12. System Shutdown

The OptoNAV system will shut down automatically on RTG power down.

6. Admin Mode

6.1. Overview

OptoNAV has a built in administrator mode which provides the ability to automatically survey sections of the port, define the lane limits and auto-record data for problem finding. These options are located at the top of the screen under 'File' and 'Settings' and require and expert user for access. Information on what is available through the admin mode is detailed below. Please see 'F064990-09-0004 OptoNAV Set-up and Installation Guide' for full instructions and detailed use.

6.2. Auto - Survey

The auto-survey function is used to teach the software to recognise designated areas of the port. When encountering a drive-line that has not been previously surveyed or one with known errors the auto-survey function will store the drive line with the required information to the library for use.

6.3. Define Lines

The lane limits provide a guideline for the RTG movement and is used as a safety mechanism to alert the driver when they are moving off course. The lines can be altered to provide different tolerance levels for RTG movement.

6.4. Auto-Record

Auto Record is used to aid the development of the OptoNAV software. When enabled the system will capture the data received in normal use or it can be left running unattended. Auto record will prompt the OptoNAV software will capture an image from both cameras and save them with the name specified as the current date and time. At the same time current GPS position (Northings, Eastings & Height) is recorded to a log file. Data can be opened and interrogated at a later date.

7. Support

7.1. Contact Details

OptoNAV was developed by Forsberg Services Ltd. please contact for all support enquiries.

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